

Claims 1-7 (Canceled).

- 1  
8. A method comprising:
- creating a communications line with two or more twisted copper pairs of wire in one or more binders;
  - receiving from said two or more twisted pairs across two or more receivers physical layer signals that have been coordinated across two or more transmitters; ~~and~~
  - exploiting a correlation between measured interference noise values across two or more of said receivers to reduce interference noise in the physical layer signals; and maximizing a SNR (Signal-to-Noise Ratio) in each frequency bin of one or more frequency bins across the communications line,
  - wherein the two or more receivers and the two or more transmitters utilize a Discrete Multi-Tone architecture having the one or more frequency bins, and
  - wherein the receiving physical-layer signals across two or more receivers is performed in a frequency domain, independently for each frequency bin of the one or more frequency bins, and further wherein the receiving physical-layer signals across two or more receivers comprises:
    - multiplying a transmitted symbol vector, whose elements are one or more individual symbols intended for each of the ~~one~~ two or more transmitters, with a MIMO (Multiple Input Multiple Output) pre-processing matrix, to generate multiplied transmitted vectors;
    - sending the multiplied transmitted vectors to an IFFT (Inverse Fast Fourier Transform) for conversion into time-domain waveforms;
    - converting a received symbol vector into frequency-domain symbols via a FFT (Fast Fourier Transform); and
    - multiplying the frequency domain symbols with a MIMO post-processing matrix wherein the MIMO pre-processing matrix and the MIMO post-processing matrix are designed separately for each frequency bin of the one or more frequency bins,

9. (Canceled).

<sup>2</sup>  
~~10.~~ The method of claim <sup>1</sup>~~9~~, further comprising designing the MIMO post-processing matrix used in each frequency bin of the one or more frequency bins to perform

pre-whitening the interference noise across the communications line, and acting as a matrix FEQ (Frequency Equalizer) to equalize effects of a shortened multilane communications channel on the transmitted symbol vector.

<sup>3</sup>  
~~11.~~ The method of claim <sup>2</sup>~~10~~, wherein the pre-whitening further comprises: restricting the interference noise onto a subspace of a smallest possible dimension in a signal space; and providing one or more independent directions in the signal space to be free of the interference noise.

<sup>4</sup>  
~~12.~~ The method of claim <sup>3</sup>~~11~~, further comprising designing the MIMO pre-processing matrix used in each frequency bin of the one or more frequency bins to be Hermitian, so that a transmitted signal power across the two or more twisted copper pairs is preserved; and yield an identity matrix when pre-multiplied by a main channel transfer matrix for a same frequency bin of the one or more frequency bins and the MIMO post-processing matrix for the same frequency bin of the one or more frequency bins.

Claims 13-19 (Canceled).

5

20.

A system comprising:

means for creating a communications line with two or more twisted copper pairs of wire in one or more binders;

means for receiving from said two or more twisted pairs across two or more receivers physical layer signals that have been coordinated across two or more transmitters; [[and]]

means for exploiting a correlation between measured interference noise values across two or more of said receivers to reduce interference noise in the physical layer signals; and

means for maximizing a SNR (Signal-to-Noise Ratio) in each frequency bin of one or more frequency bins across the communications line,

wherein the two or more receivers and the two or more transmitters utilize a Discrete Multi-Tone architecture having the one or more frequency bins, and

wherein the means for receiving the physical-layer signals across two or more receivers is performed in a frequency domain, independently for each frequency bin of the one or more frequency bins, and further wherein means for receiving physical-layer signals across two or more receivers comprises:

means for multiplying a transmitted symbol vector, whose elements are one or more individual symbols intended for each of the ~~one~~ two or more transmitters, with a MIMO (Multiple Input Multiple Output) pre-processing matrix, to generate multiplied transmitted vectors;

means for sending the multiplied transmitted vectors to an IFFT (Inverse Fast Fourier Transform) for conversion into time-domain waveforms;

means for converting a received symbol vector into frequency-domain symbols via a FFT (Fast Fourier Transform); and

means for multiplying the frequency domain symbols with a MIMO post-processing ~~mix~~ matrix

wherein the MIMO pre-processing matrix and the MIMO post-processing matrix are designed separately for each frequency bin of the one or more frequency bins.

21. (Canceled).

<sup>6</sup>  
~~22~~. The system of claim <sup>5</sup>[[21]] ~~20~~, further comprising means for designing the MIMO post-processing matrix used in each frequency bin of the one or more frequency bins to perform

pre-whitening the interference noise across the communications line, and  
acting as a matrix FEQ (Frequency Equalizer) to equalize effects of a shortened multiline communications channel on the transmitted symbol vector.

<sup>7</sup>  
~~23~~. The system of claim <sup>6</sup>~~22~~, wherein means for pre-whitening further comprises:  
means for restricting the interference noise onto a subspace of a smallest possible dimension in a signal space; and  
means for providing one or more independent directions in the signal space to be free of the interference noise.

<sup>8</sup>  
~~24~~. The system of claim <sup>7</sup>~~23~~, further comprising means for designing the MIMO pre-processing matrix used in each frequency bin of the one or more frequency bins to  
be Hermitian, so that a transmitted signal power across the two or more twisted copper pairs is preserved; and  
yield an identity matrix when pre-multiplied by a main channel transfer matrix for a same frequency bin of the one or more frequency bins and the MIMO post-processing matrix for the same frequency bin of the one or more frequency bins.

Claims 25-42 (Canceled).

9

48.

A system comprising:

a communications line with two or more twisted copper pairs of wire in one or more binders;

two or more receivers coupled to the communications line;

two or more transmitters coupled to the communications line;

physical-layer signals coordinated across the two or more twisted copper pairs of wire by the two or more transmitters and received from said two or more copper pairs across the two or more receivers; and

the two or more receivers reducing interference noise by exploiting a correlation between measured interference noise values across the two or more receivers,

wherein the reduced interference noise includes out of domain components of interference noise, and

wherein the two or more receivers and two or more transmitters utilize a Discrete Multi-Tone architecture having one or more frequency bins, and

wherein the physical-layer signals are received in a frequency domain, independently for each frequency bin of the one or more frequency bins, and

further wherein the two or more receivers:

multiply a transmitted symbol vector, whose elements are one or more individual symbols intended for each of the ~~one~~ two or more transmitters, with a MIMO (Multiple Input Multiple Output) pre-processing matrix, to generate multiplied transmitted vectors;

send the multiplied transmitted vectors to an IFFT (Inverse Fast Fourier Transform) for conversion into time-domain waveforms;

convert a received symbol vector into frequency-domain symbols via a FFT (Fast Fourier Transform); and

multiply the frequency domain symbols with a MIMO post-processing matrix,

wherein the two or more receivers maximize a SNR (Signal-to-Noise Ratio) in each frequency bin of the one or more frequency bins across the communications line, wherein the MIMO pre-processing matrix and the MIMO post-processing matrix are designed separately for each frequency bin of the one or more frequency bins.

44. (Canceled).

10

~~45.~~ A system comprising:

a communications line with two or more twisted copper pairs of wire in one or more binders;

two or more receivers coupled to the communications line;

two or more transmitters coupled to the communications line;

physical-layer signals coordinated across the two or more twisted copper pairs of wire by the two or more transmitters and received from said two or more copper pairs across the two or more receivers; and

the two or more receivers reducing interference noise by exploiting a correlation between measured interference noise values across the two or more receivers,

wherein the two or more receivers and two or more transmitters utilize a Discrete Multi-Tone architecture having one or more frequency bins, and

wherein the physical-layer signals are received in a frequency domain, independently for each frequency bin of the one or more frequency bins, and

further wherein the two or more receivers:

multiply a transmitted symbol vector, whose elements are one or more individual symbols intended for each of the ~~one~~ two or more transmitters, with a MIMO (Multiple Input Multiple Output) pre-processing matrix, to generate multiplied transmitted vectors;

send the multiplied transmitted vectors to an IFFT (Inverse Fast Fourier Transform) for conversion into time-domain waveforms;

convert a received symbol vector into frequency-domain symbols via a FFT (Fast Fourier Transform); and

multiply the frequency domain symbols with a MIMO post-processing matrix, and

wherein the two or more receivers maximize a SNR (Signal-to-Noise Ratio) in each frequency bin of the one or more frequency bins across the communications line, wherein the MIMO pre-processing matrix and the MIMO post-processing matrix are designed separately for each frequency bin of the one or more frequency bins, and

wherein the MIMO post-processing matrix used in each frequency bin of the one or more frequency bins pre-whiten the interference noise across the communications line, and act as a matrix FEQ (Frequency Equalizer) to equalize effects of a shortened multiline communications channel on the transmitted symbol vector.

<sup>11</sup>  
~~46~~. The system of claim <sup>10</sup>~~45~~, wherein the two or more receivers restrict the interference noise onto a subspace of a smallest possible dimension in a signal space; and  
provide one or more independent directions in the signal space to be free of interference noise.

<sup>12</sup>  
~~47~~. The system of claim <sup>11</sup>~~46~~, wherein the MIMO pre-processing matrix used in each frequency bin of the one or more frequency bins are Hermitian, so that a transmitted signal power across the two or more twisted copper pairs is preserved; and  
yield an identity matrix when pre-multiplied by a main channel transfer matrix for a same frequency bin of the one or more frequency bins and the MIMO post-processing matrix for the same frequency bin of the one or more frequency bins.

Claims 48-57 (Canceled).